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ABSTRACT

This publication presents the activities pertaining to the sixth goal of this activity guide series. The activities in this publication relate principally to the more advanced technologies and the implications of their development. These materials are appropriate for middle school and junior high school students. These activities, organized by objective under the concepts listed, are interdisciplinary. The activities are simply ideas of things students can do to help them understand the concepts. It remains for the teacher to use these ideas as desired. Activities range from preparing and delivering an energy briefing to the class using the style of Walter Cronkite and information collected from the news media to listing the various kinds of educational requirements needed to pursue a career in technology. (MR)

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FUTURE sources of energy

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ENERGY AND MAN'S ENVIRONMENT

Activity Guide

An Interdisciplinary Teacher's Guide to

Energy and Environmental Activities

Section Six

FUTURE SOURCES OF ENERGY

John Jones, Editor

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Illustrations and graphics were prepared by Chloe Poole and Omer Gosnell.

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FUTURE SOURCES OF ENERGY

Introduction

Future energy sources include pie-in-the-sky dreams which violate one or more natural laws, to realistic alternatives, to the squandering our remaining fossil fuel resources. Clearly, when one examines the future he/she is struck with a sobering fact: We are consuming our energy sources faster than we are able to bring alternatives into practicality. As a result, an energy gap began to appear in the 1970's. It manifested itself as a geopolitical struggle between the energy producing nations and those nations which must import energy resources to meet their needs.

Increases in oil prices of over ten-fold in a few short years has stimulated the energy-intensive nations to investigate and develop new energy technologies and sources which will make them less dependent upon the producer countries. Large amounts of capital and considerable time will be required to make new energy sources practical. There has historically been from three to five decades between first speculation to commercial feasibility. Trends in the mid-1970's suggest that sufficient capital is not available to build the sophisticated nuclear electric power plants which are now technically feasible. Therefore, consideration of alternative sources to fossil fuels will require a major research and development effort. These sources must be weighed in regard to their cost per unit of energy to install and operate as well as the environmental and social costs which may accrue to a given system.

Nuclear fission is an increasingly important contributor to the "energy mix." The splitting of uranium and other atoms in a controlled chain reaction liberates energy

which is needed to power a more-or-less conventional thermal-electric power plant. However, due to sophisticated technology and environmental protection requirements, these plants are increasingly expensive. Through at least the 1990's nuclear power plants will provide a limited supply of electric power for home, industrial and commercial use.

Nuclear fusion is a much discussed but probably distant future source. Fusion requires the attainment of extremely high temperature. Recovering useful energy from this operation will require the development of new engineering techniques and technologies. Fusion will not be a viable option for many years to come.

Solar power is already a reality if you consider that fossil fuels and rainwater behind a dam are really stored solar energy. Direct use of solar energy is common on a small scale in many desert climates of the world for heating water and buildings; but it will become increasingly economic in other climates as conventional fuel costs rise. Even in cloudy climates there is considerable solar radiation penetration which can be used to supplement other sources.

Direct conversion of sunlight to electricity is common to the photocells used in automatic cameras and light-switching applications. However, large scale conversion has been hampered by costs and low efficiencies typically under 15%.

Geothermal energy is the heat derived from the earth. Initially it is the heat which came from the radioactive decay of minerals in the earth's interior. It is most evident in regions of high heat flow and volcanism, and active mountain building. It has been exploited with great success in areas of the western United States, Italy,

Iceland, New Zealand and Mexico. Dry steam is considered to be the highest quality geothermal resource, followed by wet steam, hot water, and brine. Technologies for using dry and wet steam for power generation and heating are well known. The general use of hot water is still in the "future", especially where the geothermal water has large quantities of minerals dissolved in it. Wherever geological conditions are appropriate geothermal energy is a real possibility. It may be especially useful in direct space heating and conversion to electrical power.

Future sources of energy might also include improved recovery techniques for existing supplies of hydrocarbons, windmills, magnetohydrodynamics (MHD) for improving present coal plant efficiency, and schemes to harness the power of the tides and ocean currents. The energy mix is certain to change markedly in the next few decades.

Activities in this section relate principally to the more advanced technologies and implications of their development.

Dan Horn

EVALUATION

Future Sources of Energy

The ENERGY and MAN'S ENVIRONMENT program actively seeks your ideas, comments, and general suggestions about this Activity Guide. If you feel there are ways this Activity Guide could be improved, or if more or different learning objectives or activities could be added, please let us hear from you. We plan to contact you in the near future to ask your opinion about the activities which you have used in your classroom. In anticipation of our request, we ask that you keep a careful record of all specific activities which are tried in your classroom. Please rate the effectiveness of each activity according to the following scale.

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 highly effective 4 5	Comment Suggestion
			EXAMPLE		
Sources	III	B	2	✓	students enjoyed very much
Sources	III	B	5	✓	students enjoyed very much
Uses	II	A	3	✓	too difficult for age level

EVALUATION Future Sources of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

EVALUATION Future Sources of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

concept: I - New energy technology may be developed in the future.

future

objective: A - The student will describe the technology that will be required to improve existing energy systems.

activities

1. Using the style of Walter Cronkite, Edward R. Morrow, et al., prepare and deliver a daily "energy briefing" for your class (school) using information collected from the news media. Include a report describing your community electric generating plant in the year 2050.

2. Create a collage of new energy technologies appearing in newspapers and magazines.

3. Prepare a chart noting presently unacceptable energy-related problems and the necessary steps required to overcome the difficulties.

4. Draw a Rube Goldberg machine designed to overcome all unacceptable energy-related environmental conditions.

5. Contact the environmental specialist at your local electric utility. Ask him to outline the major devices now in use or being developed to protect the community and ensure environmental quality.

   a. What is a scrubber?
   b. What are particulate emissions?
   c. What is the cost of the devices used on power plants?
   d. How does our electric bill reflect environmental protection efforts?

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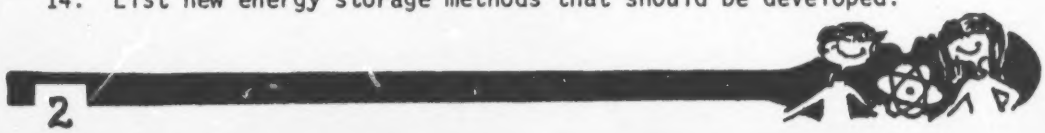
concept: I - New energy technology may be developed in the future.

future

objective: B - The student will identify the principle energy sources and systems that may be available to us in the future.

activities

1. Discuss the difference between "science" and "technology". Prepare definitions that everyone can agree upon.
2. Find pictures of nuclear electric generating plants. Identify the purpose for each of the major structures.
3. Using diagrams and pictures of new energy facilities (nuclear plant, strip mine, etc.) redesign the facilities so they are more aesthetically pleasing and attractive.
4. Keep a class journal recording new energy technological developments. Write a brief summary describing the purpose for which the new technology has been developed.
5. Prepare a time-line for the wall. Identify the approximate dates for the commercial development of solar, wind, tide, geothermal, nuclear fast breeder reactors, fusion reactors, etc.
6. On a map of the U.S./world, identify the location of major deposits of coal, oil, oil shale, tar sands, uranium, geothermal.
7. Enumerate potential energy sources. Outline the principal economic, technologic and environmental difficulties presently associated with each.
8. Prepare a list of criteria for judging the suitability of a region for solar energy development (or geothermal, wind, tidal, nuclear, etc.).
9. Using the criteria developed in #8, map those geographic areas of the U.S. where solar energy might be developed.
10. Select the major source of electric power you think will be most used in the future, and substantiate that choice.
11. List some of the underdeveloped sources of energy.
12. Discuss the most likely ways of using new energy sources.
13. List some methods currently being used for energy storage and describe each.
14. List new energy storage methods that should be developed.



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activities

Concept I
Objective B

15. Present methods of energy transmission and transportation.

16. Discuss the impact of improved energy transmission and transportation on underdeveloped energy sources.

17. Construct a "time line" for the planning and construction of a nuclear power plant, coal fired plant, oil fired plant, others.

18. Using electric magnets to suspend an object in mid-air show the containment of fusion reaction.

19. Describe the energy production process of a nuclear fission reaction:

a. Light water reactor
b. Gas cooled reactor
c. Breeder reactor

20. Demonstrate a chain reactor using ping pong balls and many mouse traps. Relate it to fission reaction. Explain how it should be done.

21. Describe the energy production process of solar radiation:

    a. Direct conversion
    b. Indirect conversion

22. Construct a small solar air heater and test its operation. (Use as reference Popular Science and Direct Use of the Sun's Energy, Ballantine Books $1.95.)

    Construct a small solar water heater and test its operation under various circumstances. (How long, in bright sunlight, on how hot a day, does it take to heat a given amount of water to what temperature?) Graph out the results.

23. Test a solar cell (selenium) and determine the number of square feet of cells under optimum light conditions that would be required to provide an average house with its electrical needs during the hours of optimum light conditions only. The cost at 1/3 that of commercially available solar cells could be used to determine the cost feasibility.

24. Fill a series of corked test tubes into which a hole has been drilled and a thermometer inserted. Behind each test tube place a different sheet of colored paper (black, blue, red, white, green, foil).

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activities

Concept I
Objective B

25. Record the temperature of each thermometer. Allow each to be exposed to the sunlight for five minutes. After the five minute exposure, read the thermometer again and record the temperature. Are there any differences? Continue the experiment for thirty minutes, recording all the temperatures every five minutes. Is there a relationship between color and heat energy trapped by solar energy?

26. Repeat the experiment by wrapping each tube completely by the colored item, and leave each one wrapped for one-half hour after making an initial temperature reading. Explain any differences observable from the first set of data.

27. What implications does this experiment have on solar energy? What color would you paint a solar absorption panel?

28. Construct cartoons showing the problems of using solar energy as the sole means of heating a house.

29. Assume that an orbiting space platform is equipped with cells to convert solar energy to electric energy. List three or more ways to get that energy to earth.

30. Describe the energy production process of geothermal power.

31. Describe the energy production process of wind power.

32. List the advantages and disadvantages of wind driven water pumps or power generators.

33. Interview a farmer who uses a wind driven pump to determine the value of using wind energy for that purpose.

34. Describe the energy production process of the ocean:

    a. Thermal gradient
    b. Tidal
    c. Wave motion
    d. Ocean currents

35. Describe the energy production process of magnetohydrodynamics (MHD).

36. Describe the energy production process of bioconversion.

37. Visit a sanitary land-fill project in the area and list five items that might have been recycled, reused, or burned to produce heat.

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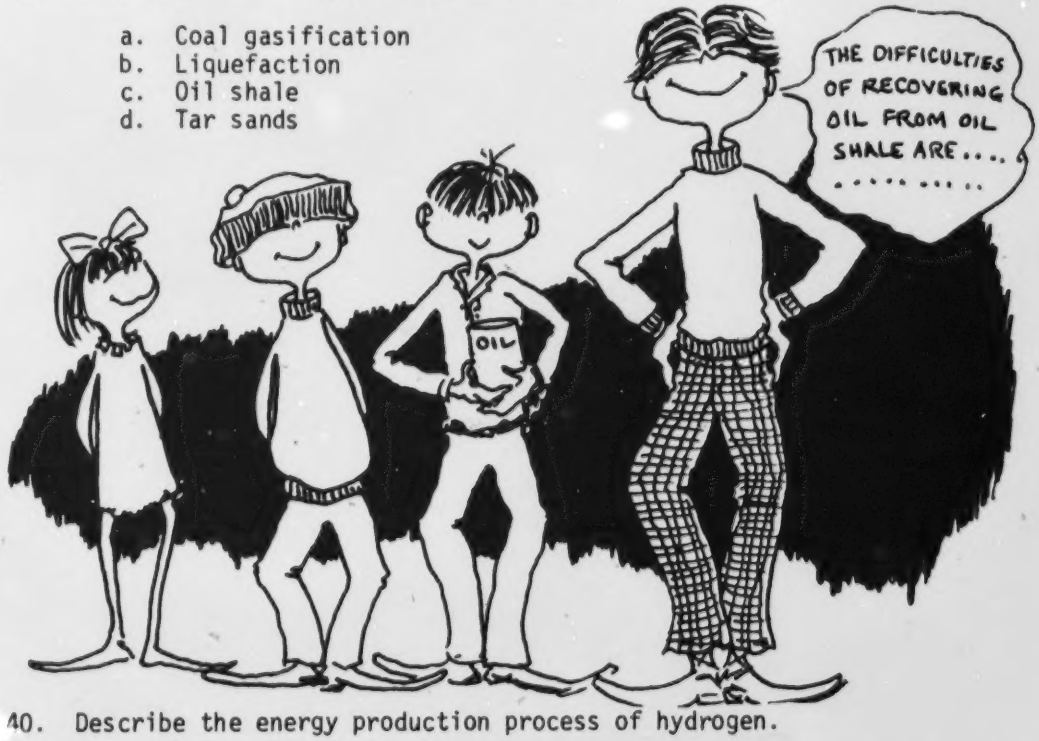
activities

Concept I
Objective B

38. Discuss how garbage utilities of the future might be able to cut costs by requiring the householder to separate cans, bottles and burnable materials which can be used as a source of energy.

39. Describe the energy production process of fossil fuel conversions:

    a. Coal gasification
    b. Liquefaction
    c. Oil shale
    d. Tar sands



40. Describe the energy production process of hydrogen.

41. Do electrolysis of water by placing electrodes in separated test tubes.

    At the negative electrode, hydrogen gas will be generated at twice the rate of oxygen in the other tube.

    a. Use a burning splint to ignite the hydrogen gas in its tube. This activity demonstrates the ability of electricity to convert water to hydrogen and oxygen which can be used as a pollution free fuel.

    b. Describe the limitations and advantages of obtaining hydrogen by electrolysis and then using it as a basic power source.

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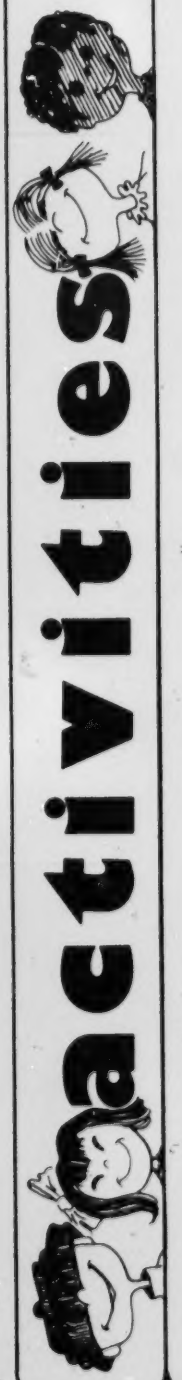
concept: II - Future energy technologies will be judged by their combined economic, social, political, technical and environmental impacts.

future

objective: A - The student will describe aesthetically acceptable energy production and utilization methods.



activities

1. Identify and analyze base criteria for establishing aesthetic guidelines for energy facilities.

2. List and describe desirable aesthetical aspects of the following energy facilities:

   Strip mines
   Deep mines
   Thermal generating plants (fossil and nuclear)
   Wind generators
   Geothermal plants
   Ocean energy plants
   Solar central generation plants
   Solar panels for buildings
   Others

   Divide children into groups and have each group design the best aesthetical location for one of the facilities listed. Each group must justify to the total class satisfaction their location and the development of these facilities.

3. Identify the most aesthetically acceptable energy production cycles (excavations - construction - operation).

4. Define and weigh economic costs vs. social benefits as related to aesthetic requirements for energy production facilities.

5. Evaluate the aesthetic vs. economic aspects of land reclamation.

6. Prepare a series of drawings depicting the cyclic aspects of mining (before, during, after).

7. Survey the noise levels of various community situations such as department stores, streets, freeways, office areas, classrooms, etc. Interview the people who work or live in those environments to determine if they think that environment is satisfactory as far as noise is concerned. Determine what noise irritants they find most objectionable. Attempt to determine what effect noise has on them. For instance, does it make them irritable? Is it a detriment to concentration? Does it result in a reduction of job proficiency? Does it result in any physical disability? What else?

   (Teacher's Instruction: Use a sound-level meter from page 11 of Sound Pollution, by Peter A. Brysse.)

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activities

Concept II
Objective A

8. Describe appropriate noise-level standards for transportation pathways and housing developments.

9. Gather pictures of various ways energy is transmitted and stored. Project the pictures on a screen. Discuss them and decide which ones are acceptable. Justify their selection.

10. Describe acceptable means of transmitting and storing energy.

11. Describe the most aesthetically acceptable forms of energy for efficient housing and transportation.

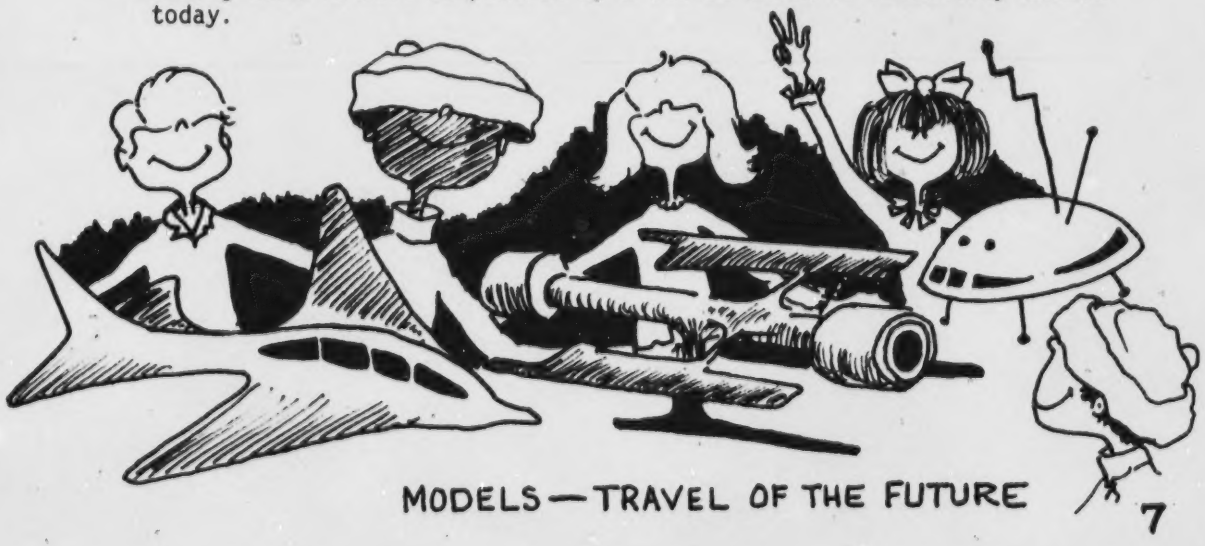
12. Describe aesthetically the best location for solar cells, solar reflectors, nuclear reactors to generate electricity, recycling centers.

13. List the major factors involved in the siting of a nuclear power plant relating each factor to aesthetic considerations.

14. After determining the site requirements of a nuclear fueled power plant and after considering human aesthetic needs, design a setting for that plant and build a model of it - then write a set of guidelines for human aesthetic site requirements.

15. Describe the aesthetic advantages of advanced recycling systems, e.g. using sewage and garbage as opposed to present disposal methods.

16. Design the most aesthetically acceptable form of transportation, remembering that it must be powered by a source which is relatively unused today.



MODELS—TRAVEL OF THE FUTURE 7

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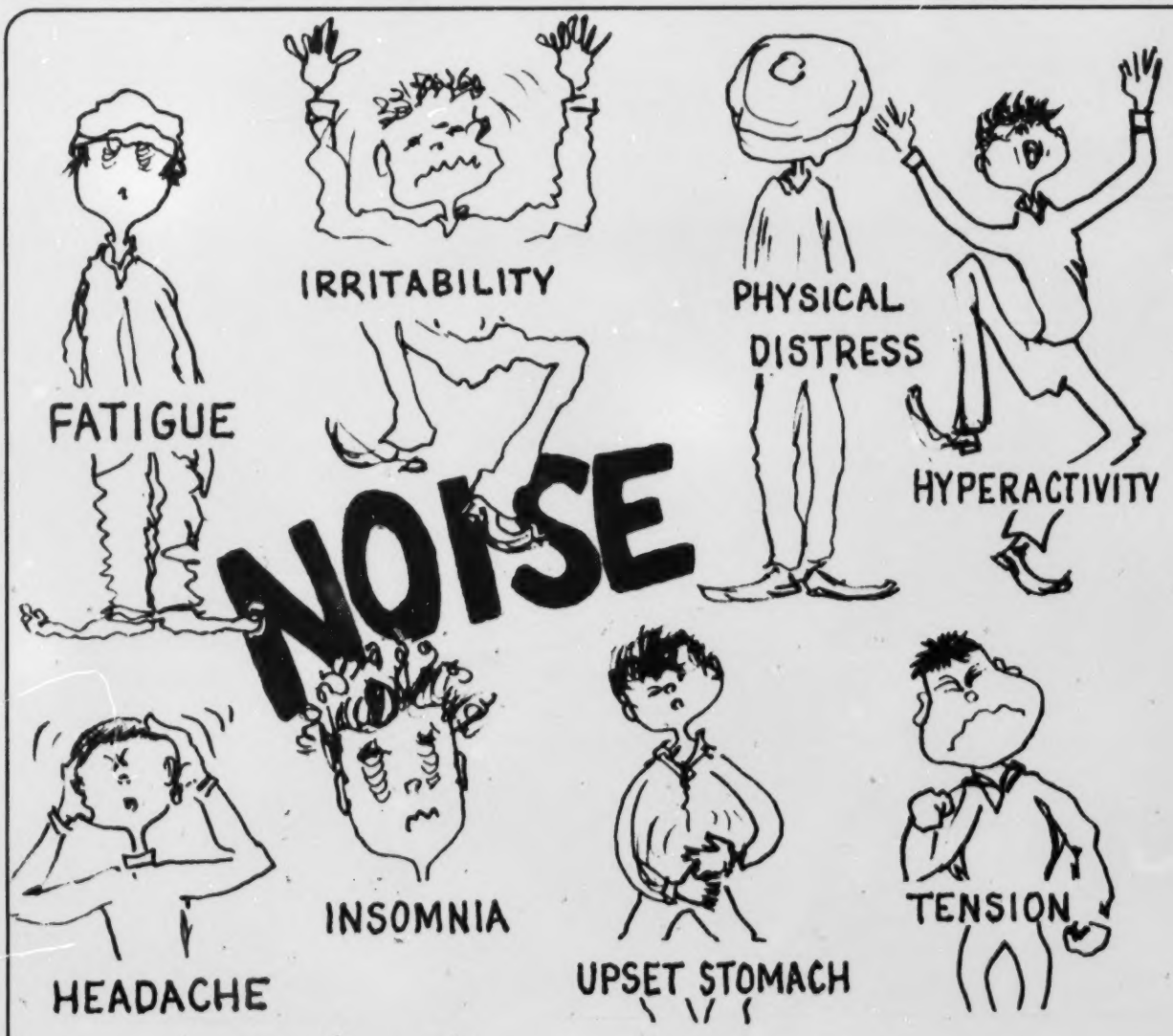
activities



17. Interview persons in your neighborhood concerning the effects noise has on them. Tabulate the results.

Does noise cause:	Yes	No
Fatigue		
Irritability		
Physical distress		
Headache		
Insomnia		
Upset stomach		
Tension		
Hyperactivity		

8 (Teacher's instruction: refer to Sound Pollution, Brysse.)

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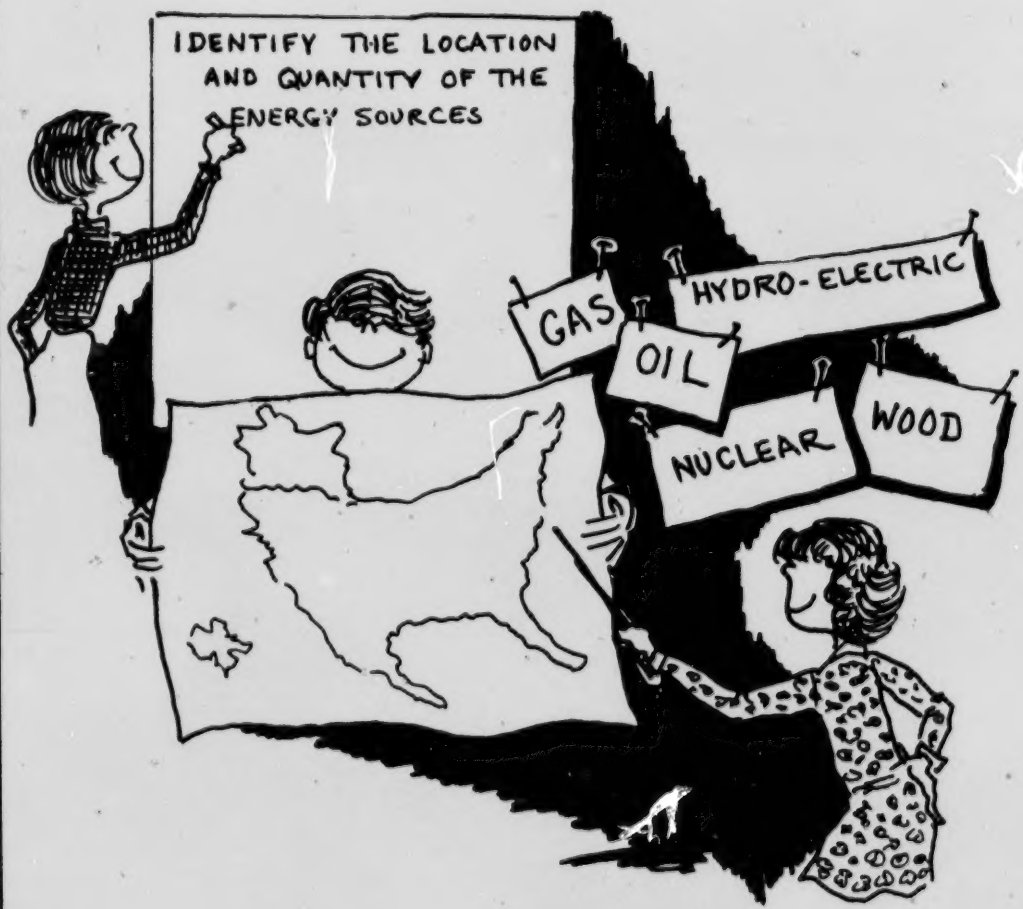
concept: II - Future energy technologies will be judged by their combined economic, social, political, technical and environmental impacts.

future

objective: B - The student will describe the ways the geographic location and geological makeup of a nation influences its energy utilization practices.

activities

1. Using a map of the United States identify the location and quantity of various energy sources.
2. Identify the principle types of energy usage in various geographical United States areas.
3. Relate types of energy usage to geographical locations of the fuel source.



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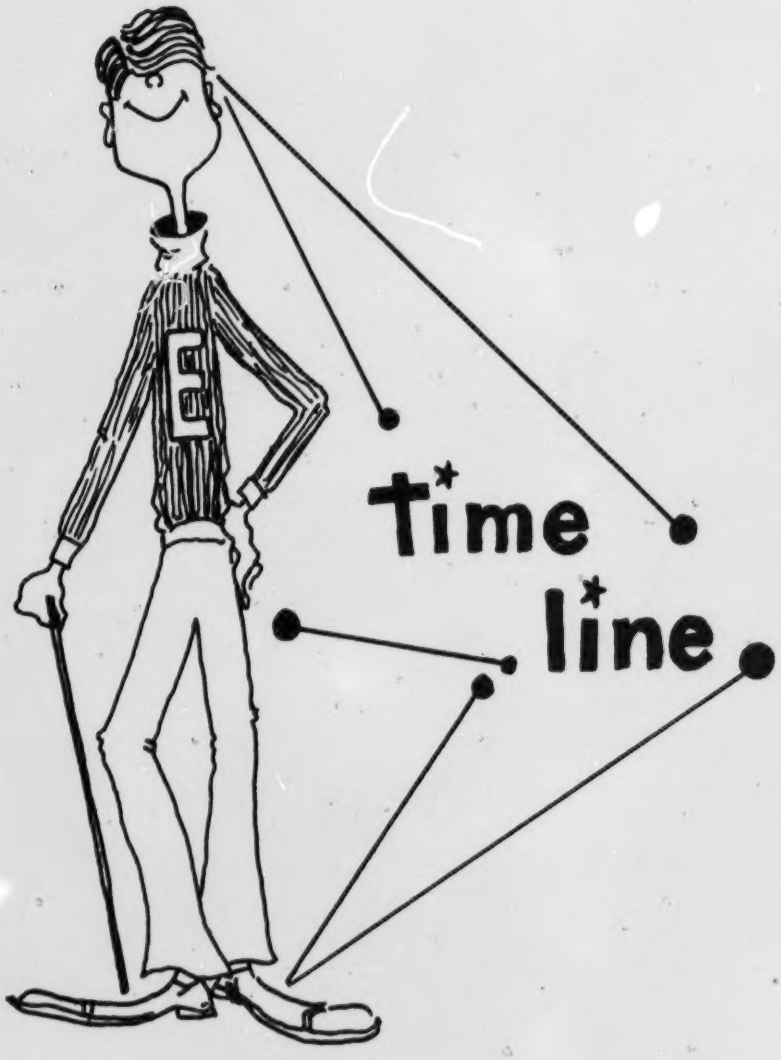
concept: II - Future energy technologies will be judged by their combined economic, social, political, technical and environmental impacts.

future

objective: C - The student will identify the energy sources which will be available in diminishing quantities in the future.

activities

1. List the principal energy sources which will be available in diminishing quantities in the future.
2. Prepare a time line showing the life span for major energy sources.



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concept: II - Future energy technologies will be judged by their combined economic, social, political, technical and environmental impacts.

future

objective: D - The student will describe the characteristics of the "ideal" energy source.

activities

1. Identify the economic aspects of various energy sources.
2. Evaluate the environmental "protective" costs of energy facilities.
3. Evaluate the economic impact of international pollution.

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concept: II - Future energy technologies will be judged by their combined economic, social, political, technical and environmental impacts.

future

objective: E - The student will list energy policy decisions that are made representing various known energy sources in the U.S.

activities

1. Identify and draw a map representing various known energy sources in the U.S.

2. Discuss the political-economic consequences of energy-wealthy states in the U.S. passing state level legislation banning the export of their energy resources.

3. Discuss the impact of this provincial attitude on an international level.

4. Discuss the international environmental impact of transporting fossil fuels between nations, (oil spills, LNG, spillage).

5. Identify the various federal, state and local governments involved in formulating rules and licensing:

   a. nuclear power plants
   b. coal fired plants
   c. other thermal plants
   d. pipe lines (coal, oil, gas)
   e. price structure) regulation
   f. marketing practices)

6. Discuss the political-economic-environmental aspects of strip mining, shale oil and tar sand processing.

7. Work in committees of four to plan a community which heats and cools all its structures with heat from the condensation loop (dump loop) of the local thermoelectric plant.

   (Refer to Environmental Impact Statements from any thermo-electric plant. The modern generation nuclear plant may produce as much as 1,500,000 kilowatts of excess heat energy per hour or enough to heat more than 100,000 homes.)

8. Appoint a panel of members to debate the advantages and disadvantages of locating thermal electric plants in or near population centers.

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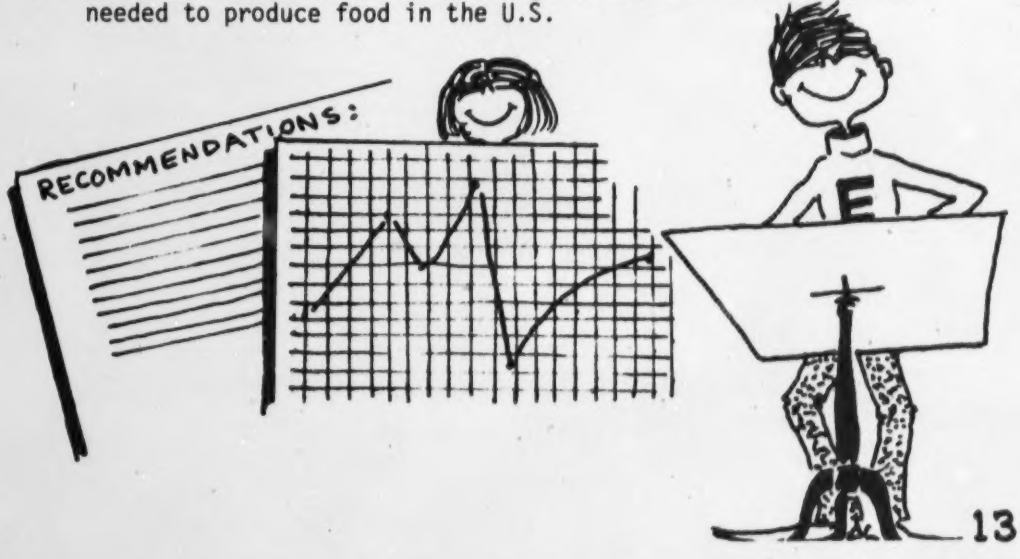
concept: III - Future energy technologies may provide abundant energy with which to modify the environment.

future

objective: A - The student will describe the raw resources in the U.S. and the number of years each will last at the present rate of consumption.

activities

1. Chart five resources in the U.S. How many years will each last at the present rate of consumption?
2. Map the location and record the quantity of the raw resources listed in U.S. Govt. Critical Commodities List.
3. Chart a graph showing the critical commodities consumption and projected growth.
4. Identify those natural resources critical to energy facilities construction, e.g. fusion devices, solar cells, etc.
5. Identify critical raw resources required for U.S. energy production facilities but available by import only.
6. Discuss the international-political-economic aspects of critical raw commodities needed for energy development.
7. Manipulate the Energy Research and Development Administration's Energy Simulator in ways that make the fossil fuel resources last 1000 years. (The Energy Simulator is available from ERDA, Federal Building, Richland, Washington.)
8. Make recommendations for reducing the amount of chemical fertilizer needed for present food production in the U.S. (See Scientific American Sept. 1974.)
9. Make recommendations for reducing the amount of insecticides needed to produce food in the U.S.



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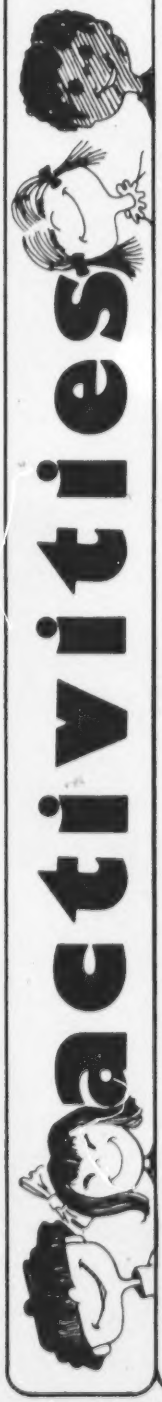
concept: III - Future energy technologies may provide abundant energy with which to modify the environment.

future

objective: B - The student will discuss the value of recycling materials as a method of extending natural mineral supplies.



activities

1. Examine ways industry manufactures materials that can be recycled and discuss the value of recycling or reusing materials.
2. Chart the known critical raw resources available in comparison to the resources that can be made available from recycling existing materials.
3. Determine the net quantity resources lost during recycling.
4. Determine the environmental impact of a recycle society as compared to a non-recycle society.
5. How will future energy production be affected by mineral resource shortages?
6. Evaluate the merits of garbage sorting versus total pickup, e.g. separation of fats, metals, bottles, bundles, and other materials, and the feasibility of it.

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concept: IV - Energy availability will affect future life styles and cultural conditions.

future

objective: A - The student will describe the relationship between individual energy consumption and quality of life.

activities

1. Divide the class into groups of four. Each group will list the characteristics of a life style that they would find most satisfying. One representative from each group then will act as a group using their combined lists to arrive at a list characterizing the "good life".

   The class will again work in groups to design a life style, using the characteristics of the "good life" which uses as little energy as possible.

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concept: IV - Energy availability will affect future life styles and cultural conditions.

future

objective: B - The student will describe personal liberties which may be affected by changes in future availability of energy.

activities

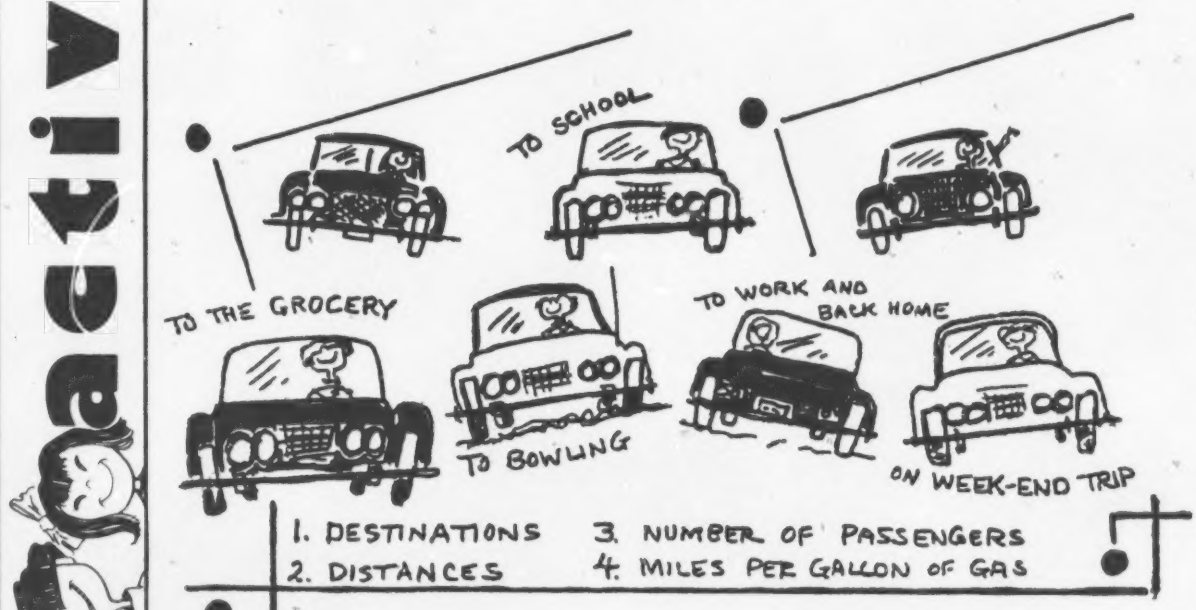
1. List three energy sources and two examples of personal liberties which would be affected by the shortage of these energy sources.

2. Given the circumstance of gas being permanently rationed to five gallons per week, the class as a whole will discuss the personal freedoms they have now that would be modified as a result. They might also discuss all other aspects of gas rationing that would cause them inconvenience or change their consumer patterns.

3. Given the prospect of a permanent gasoline shortage, students will select from several alternatives (suggested by them and listed on the chalk board by the teacher) one they would prefer and be prepared to defend that choice.

   The alternatives might include:

   a. rationing one automobile
   b. limited allocations to station or state
   c. no government interference
   d. raising gas prices - taxing gas
   e. banning big cars, trucks, campers, travel homes, etc.
   f. taxing automobiles by weight and horsepower



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concept: IV - Energy availability will affect future life styles and cultural conditions.

future

objective: C - The student will predict changes in land use planning priorities associated with the development of energy resources in the future.

activities

1. Play the land use simulation game available from Ernest McDonald, Education Specialist, U.S. Forest Service, P.O. Box 3623, Portland, Oregon 97208.

2. Investigate the local zoning laws and take field trips to familiarize yourself with local land use practices. Keeping in mind energy conservation practices what would you recommend for future zoning regulations? (Concentrate the population to ease transportation problems; encourage condominiums and multiple occupancy structures; hold aside areas with good soil for agriculture only, etc.)

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concept: IV - Energy availability will affect future life styles and cultural conditions.

future

objective: D - The student will compare the life styles of a relatively energy independent household to one which depends largely upon centralized energy production facilities.

activities

1. Invite people who attempt an independent rural existence (counter-culture commune members are sometimes a good choice) to tell your class about their life style in relationship to energy consumption. The students, working in groups, could construct lists of changes in their life style that would save energy, then check those that would not substantially detract from the "quality of their living". They might commit themselves to several of these, then report their success, or lack of it, back to their class members periodically.

2. Collect pictures of households, both modern and historic, and compare the energy uses of each. Suggest ways the historic households could have been more energy efficient.

3. Draw a mural depicting differences in energy consumption practices now and 100 years ago.

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concept: IV - Energy availability will affect future life styles and cultural conditions.

future

objective: E - The student will describe the consequences of exhausting the world's fossil resources.

activities

1. Coal, oil and natural gas are used as essential ingredients in the manufacture of many everyday items, including plastics, synthetic fibers for clothes, etc. Bearing in mind that these hydrocarbons are available only in finite amounts, discuss the energy mix (the relative percentages of different fuels).

2. Map the coal recoverable by strip mining in the U.S., and discuss the environmental consequences of mining all of it.

3. The gasoline crisis of 1973 was the result of a 5% reduction in supply over the previous year. Describe the life style consequences of the 50% reduction in supply we will eventually face.

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concept: IV - Energy availability will affect future life styles and cultural conditions.

future

objective: F - The student will identify ways of extending the life of the crude oil supply by reducing consumption.

activities

1. List all those consumer items which are made from fossil fuels or use fossil fuel in their manufacture. Check those items you will attempt to avoid using by discontinuing that use pattern or by substituting products that use less or no fossil fuel in their manufacture and distribution.

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concept: IV - Energy availability will affect future life styles and cultural conditions.

future

objective: G - The student will list the ways new energy sources use will affect future home and building design.

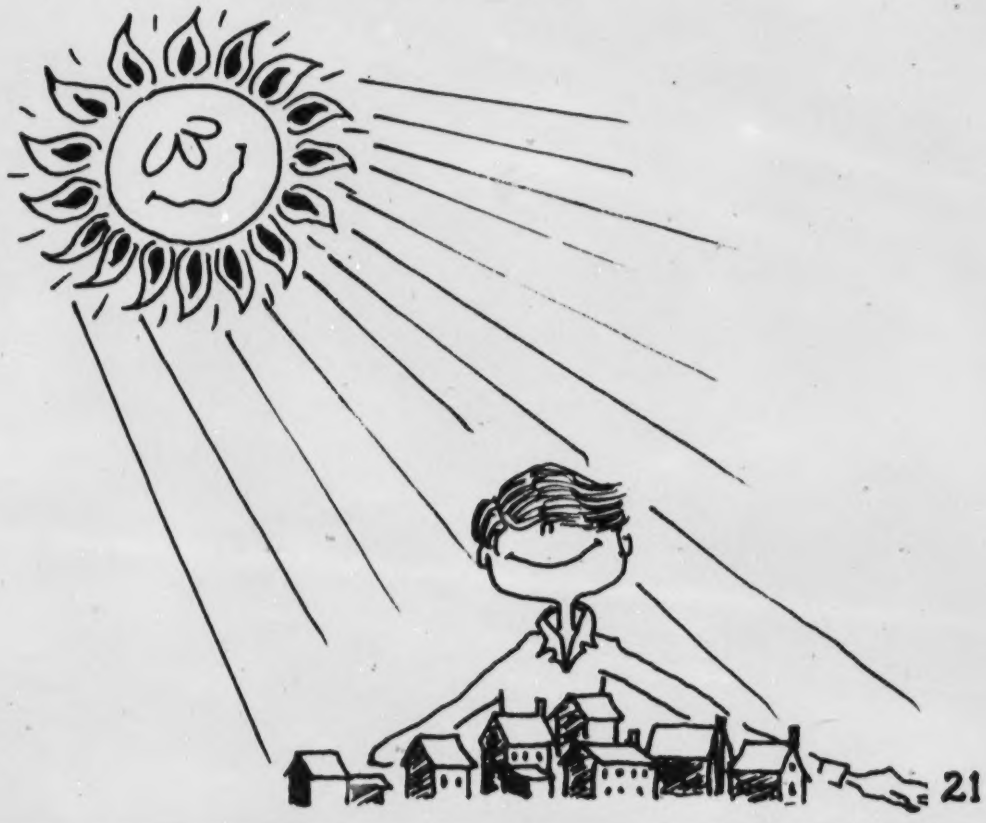
activities

1. Working in groups, design and construct model energy efficient homes.

2. Working in groups, design and construct a model home which uses solar and wind energy captured on the home site. (See Mother Earth News and Popular Science, articles on solar and wind power. See also Direct Use of the Suns Energy - Ballantine Books.)

3. Plan and build models of energy-efficient homes after hearing an architect's presentation on energy-efficient structures. (Film on Solar Heating of Schools, available from Senator Mike McCormick, Federal Building, Richland, Washington 95350.)

4. Using a Polaroid land camera, take pictures of homes that are especially energy consumptive and those that are less consumptive. (Greater as opposed to lesser space per occupant, air conditioned vs. non-air conditioned, double windows vs. single glassed, few glass windows vs. many glassed windows, etc.)



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concept: V - Future energy systems will require large amounts of economic capital.

future

objective: A - The student will identify reasons why some sources of energy are increasing in use while others are declining.

activities

1. List the effects of population density on regional energy pattern usage.
2. List three reasons why the cost of oil will gradually increase.
3. Describe why increasing the price of coal will increase the production rate.
4. Evaluate the economic competitiveness of untapped exotic energy sources.

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concept: V - Future energy systems will require large amounts of economic capital.

future

objective: B - The student will demonstrate an understanding of basic energy economics.

activities

1. Use the Energy-Economics simulation game prepared by the Edison Electric Institute.

2. Prepare a budget for a hypothetical power generating facility to be constructed by the class. Invite a utility economist to class to discuss your projections.

3. Contact your local banker or utility economist. Determine how funds are secured for maintaining existing facilities and constructing new facilities.

4. Prepare a glossary of energy economics terms. Include such terms as:
   a. Bond rating
   b. Prime rate
   c. Capital intensive
   d. Stockholder

5. Write to the Federal Energy Administration, Energy Research and Development Administration, Battelle Northwest, Richland, Washington, the Electric Power Research Institute and the Sierra Club. Request economic projections for the development of new energy systems (solar, geothermal, methane, garbage, fast breeder, fusion, wind, tide, MHD, etc.). Compare the data.

6. Determine the capital investment required to overcome economic constraints on the development of a new technology. Where will the money come from? What trade-off will be required?

7. Assess the relationship between the capital investment required to develop a new energy resource and the time required to "bring it on line."

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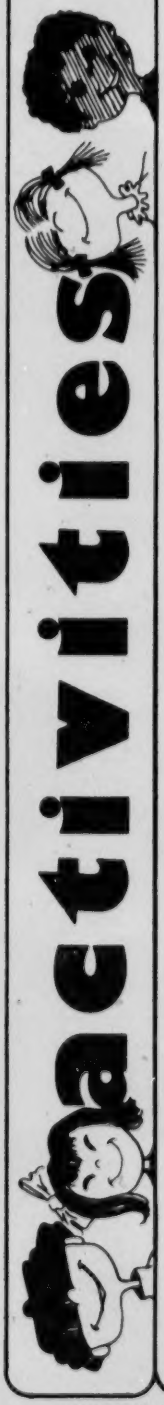
concept: VI - Energy policy decisions will affect the availability and distribution of energy in the future.

future

objective: A - The student will list energy utilization decisions over which the individual has considerable influence.



activities

1. Paint a mural showing an energy-conserving community, including houses, transportation, pets, yards, parks and recreational facilities, industry, waste disposal and business district.
2. Make a tally of cars and record the number of people per car.
3. Record the number of trips made in the family car in one week. Record the destination, the distance and the number of passengers.
4. Map the area in which you live and show the bus stops and routes which you can use to travel to your usual destinations.
5. Collect data from the Humane Society and record the number of pets which are put to death in one year.
6. Organize a program to control pet population in your city or school.
7. Place two grains of rice on one square of a checkerboard, four grains on the second square, eight grains on the third, etc., doubling the number placed on each square. Mathematics may be used to determine how many grains of rice will be on the last square. Compare these numbers with the doubling of human population every generation.
8. Debate the Oregon Bottle Recycling Law, role-playing proponents and opponents.
9. Design packaging for one specific product which is more energy conserving than the present one.
10. Devise a model housing construction code designed to conserve energy.
11. Design a check list of performance, size, weight, horsepower of five different automobiles.
12. Record items used in school and home which are disposable and could be replaced by nondisposable items.
13. Count number of students driven to school and record number of persons per car.

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activities

Concept VI
Objective A

14. Start a car pool by neighborhoods.

15. Write a proposal for a bicycle safety program and ask to read the proposal before your City Council.

16. Prepare a list of products which are packaged in energy intensive materials, not reusable and requiring disposal manpower and energy.

17. List the advantages of having a family garden.

18. Draw your family tree for the last three generations to show the increase in population of your family over a three generation period.

19. Draw five generation family trees, one with two offspring/couple and one with four offspring/couple. Compare to resultant population sizes.

20. The student will describe the energy utilization decisions which might enter into their consideration of the following listing:

    Selection of auto
    Boycott packaging of foods, etc.
    Support taxes - as related
    Mass transit
    Construction codes (insulation, heating)
    Support population control (people, pets)
    Consider standard of living, material goods (appliances, size of house, heating insulation, number of cars and size)
    Fabrics (natural vs. man-made fibers)
    Encourage low energy intensive industry
    Encourage family production of food, clothing, etc.
    Car pooling
    Support planned communities (shopping, housing, recreation)
    Bicycle paths
    Low energy intensive recreation

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concept: VII - The availability and control of energy resources condition international relationships.

future

objective: A - The student will describe the effect of new energy resources on a nation.

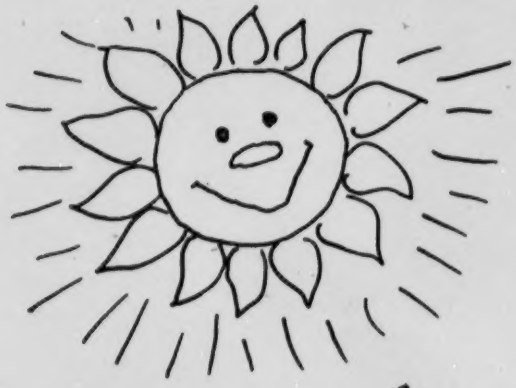
activities

1. Given the country of _____ which is characterized by:

   a. recent extensive famine
   b. large quantities of underdeveloped good quality farmland near rivers
   c. a rural agrarian population

   write a paper describing the changes which would be brought about in the country by the discovery and utilization of extensive oil deposits.

2. Identify geographical restrictions for using new energy sources, i.e. solar, geothermal, wind, ocean, etc.



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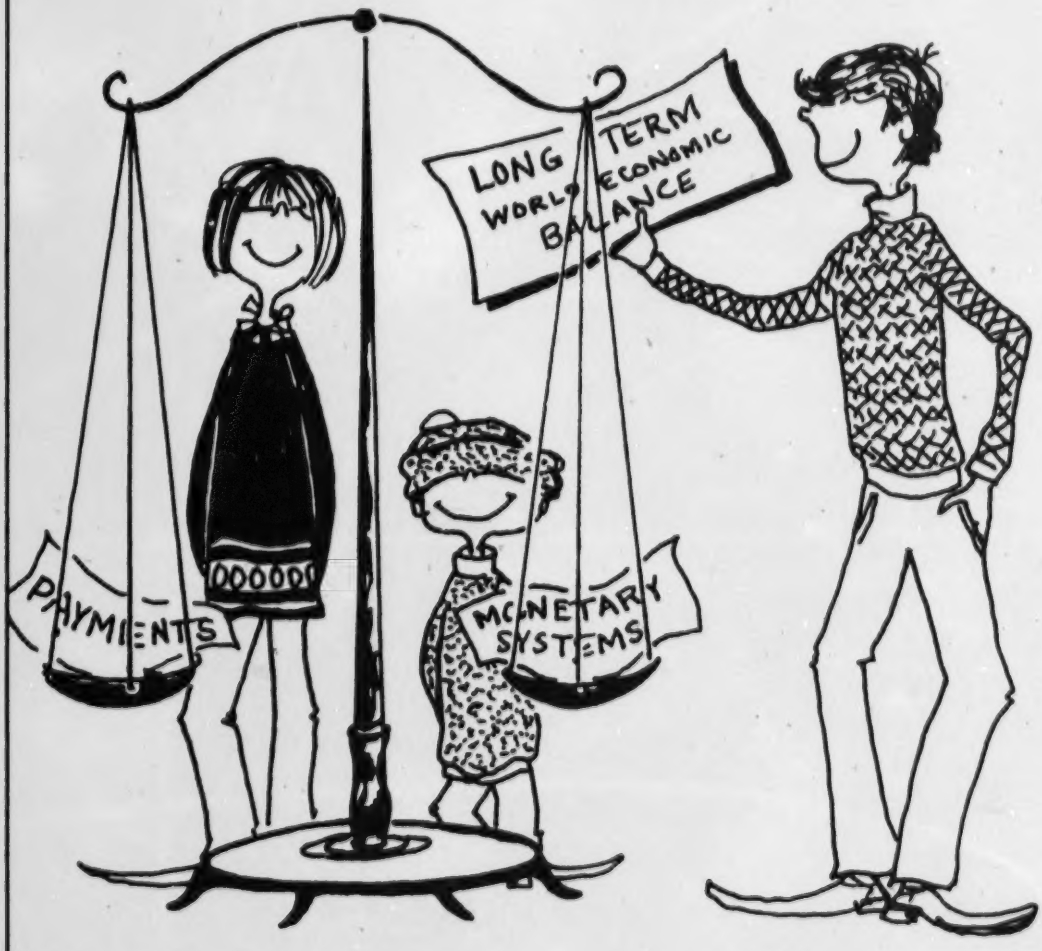
concept: VII - The availability and control of energy resources condition international relationships.

future

objective: B - The student will describe some of the national and international environmental impacts of energy accessibility and usage.

activities

1. Discuss the international political-economic problems of having energy resources and raw mineral resources concentrated within a few nations.
2. Discuss the long term world economic balance of payments as related to international monetary systems.
3. Discuss ways that energy-rich nations utilize their wealth to assist the underdeveloped nations.



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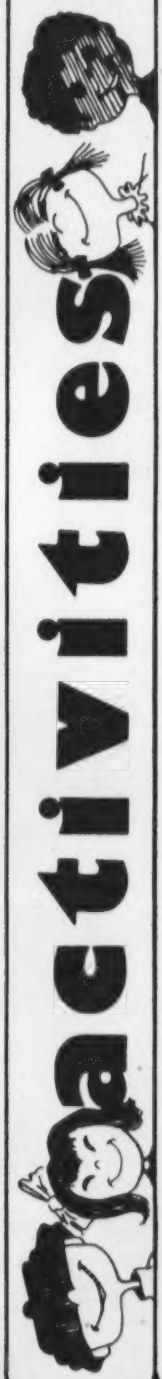
concept: VII - The availability and control of energy resources condition international relationships.

future

objective: C - The student will describe the characteristics of an energy-insufficient nation in relationship to other nations.



activities

1. Discuss how the lack of sufficient "base" energy resources will affect an energy-insufficent nation.

2. Develop a classroom game plan that will deal with the following situations:

   a. An industrialized society's energy resources face exhaustion.
   b. An industrialized society's raw material resources face exhaustion.
   c. An industrialized society is faced with the situation of having to commit a large portion of its financial and material resources toward new energy development projects.

   Discuss the three above for a nonindustrialized society.

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concept: VII - The availability and control of energy resources condition international relationships.

future

objective: D - The student will describe the characteristics of an energy-self-sufficient nation in relationship to other nations.

activities

1. Identify the world's energy-sufficient nations and relate their energy resource supplies to their raw mineral resource supplies. Map this information.

2. After identifying the world's energy and raw mineral resources, map the expected flow of these among nations of the world and discuss the political-economic impact of any constraints placed on this flow.

3. Discuss the role of the United Nations and other international organizations in dealing with the flow of energy and mineral resources among nations.

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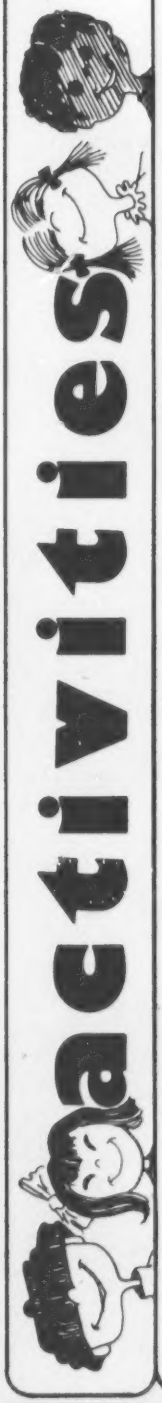
concept: VIII - Future energy development will require new job skills.

future

objective: A - The student will evaluate the effect on the job market of a shift toward a recycle society.



activities

1. List three products which are disposable now and which could be replaced by nondisposable products (of equal utility) and the career changes that would result.
2. Predict the impact on the job market of standardizing packaging and containers for reuse.
3. List items which can profitably be recycled or reused and the jobs which would be affected.
4. Select a product, such as a paper bag, and record the number of times you use it.

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concept: VIII - Future energy development will require new job skills.

future

objective: B - The student will describe jobs which would be created or eliminated in the event of new developments and technologies in energy.

activities

1. Identify three new developments or technologies in energy and the jobs which would be created or eliminated.
2. Construct a flow chart or mural illustrating the manufacture of a pollution control device. Consider the jobs created and the energy and resources used.
3. Explain the job of an environmental lawyer and the reasons for the creation of this recently created position.
4. List some careers brought about by the advent of the nuclear age.
5. List some careers that will be created by recent antipollution laws.

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concept: VIII - Future energy development will require new job skills.

future

objective: C - The student will predict the kinds of jobs eliminated and jobs created with the advent of severely limited energy resources.

activities

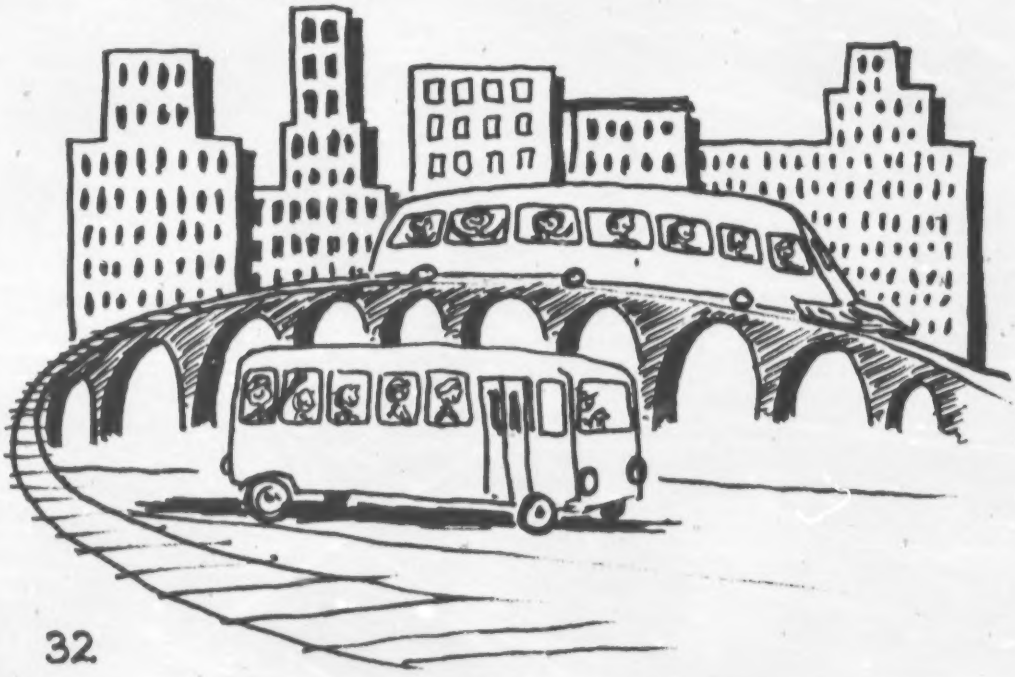
1. Chart:

   a. Three energy resources which are severely limited
   b. Jobs that will be eliminated
   c. Jobs that will be created

2. Assume you are the Mayor of your city. Describe the qualifications of the person you would hire to establish a public transportation system. Include educational background, occupational experience, political philosophy and other factors considered important. How would he be expected to approach the problem? To whom would he be answerable?

3. Discuss the jobs that would be affected and the sources of energy that would be made more available if the principal mode of transportation in a city were to change from private automobile to mass transit (buses, trains).

4. It has been suggested that through greater use of public transportation (buses, trains) private citizens would use less fuel in their cars. Suppose this were put into action. List the fuels that would be saved. Who might lose jobs? What jobs would be created?



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concept: VIII - Future energy development will require new job skills.

future

objective: D - The student will identify new job skills which have recently become necessary as a result of emerging technologies.

activities

1. Identify five new jobs or job skills which have recently become necessary as a result of emerging technologies.
2. List various kinds of educational requirements needed in order to pursue a career in technology.
3. List the educational institutions in the community which prepare students for careers in technology or science.
4. List the types of technology you would like to pursue or have someone else pursue for the betterment of our living conditions.
5. Give examples that show the difference between basic scientific research and applied technology.

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